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depositing a second metal layer by physical vapor deposition to fill a remaining portion of the contact vias over the first metal and at least partially fill the trenches, wherein the first metal has a higher resistivity than the second metal.

REMARKS

In the Office Action mailed on August 28, 2002, the Examiner rejected all pending claims. Applicants respectfully request full consideration of the amendments and the remarks contained herein.

Amendments to the Claims

Amendments have been made to the claims to further clarify the subject matter that Applicants regard as the invention. For example, Applicants have amended Claim 11 to recite that “the first metal has a higher resistivity than the second metal.” Support for this language can be found in the application as originally filed (*see, e.g.*, pp. 2-3, 5-6 and 8-11 of the application) and in the original claims (*see, e.g.*, Claims 1 and 17). Consequently, Applicants respectfully submit that the amendments add no new matter and are fully supported by the application as originally filed.

Objection to the Title

The Examiner has objected to the title, “Dual Damascene Interconnect,” as “not descriptive.” In response, Applicants have amended the title to “Method of Forming a Dual Damascene Interconnect.” Consequently, Applicants respectfully submit that the objection is overcome.

Anticipation Rejections

The Examiner has rejected Claims 1-2, 5-9, 11, 14-15 and 17-20 as being anticipated under 35 U.S.C. § 102(e) by Havemann (U.S. Patent No. 6,156,651). The Examiner stated that Havemann discloses “depositing a first metal (tungsten, 66, see col. 3, lines 19-21) ... selectively over the conductive element relative to insulating surfaces of the dual damascene structure to partially fill the contact via (see figure 6C), and filling a remainder of the contact via with a second metal (70, aluminum, see figure 6E, as claimed in claims 2, and 20) by PVD (see col. 6,

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lines 44-46), the second metal of aluminum being more conductive than the first metal of tungsten.”

Applicants respectfully traverse the rejections.

Applicants note initially that all independent claims recite at least two metals having different conductivities or resistivities. For example, independent Claim 1 recites “depositing a *first metal* ... and filling a remainder of the contact via with a *second metal*, the second metal being *more conductive* than the first metal”; independent Claim 11, as amended, recites “preferentially depositing a *first metal* ... and depositing a *second metal* layer ... wherein the first metal has a *higher resistivity* than the second metal”; and independent Claim 17 recites “depositing a *first metal* ... and filling a remainder of the contact via with a *second metal*, wherein the second metal is *more conductive* than the first metal.” (emphasis added). Applicants note that the recitation of a “first” and a “second metal” indicates that these two “metals” are not identical. Moreover, the claims recite a particular order of the metals depending on electrical properties, *e.g.*, “depositing the first metal” and then “filling a remainder of the contact via” with a “more conductive” “second metal” (Claims 1 and 17) or “preferentially depositing a first metal” having “higher resistivity than the second metal” before “depositing a second metal” (Claim 11).

With these points in mind, Applicants note that “for a prior art reference to anticipate in terms of 35 U.S.C. § 102, every element of the claimed invention must be *identically* shown in a single reference” and these “elements must be arranged as in the claim under review.” *See In re Bond*, 910 F.2d 831, 15 U.S.P.Q. 2d 1566 (Fed. Cir. 1990) (emphasis added). Consequently, for Havemann to anticipate independent Claims 1, 11 and 17, Havemann must disclose every element of Applicants’ claimed invention, with each disclosed element arranged as in Applicants’ claims.

Applicants respectfully submit, however, that Havemann does not teach depositing a “first metal” and a different “second metal” and especially not depositing a “second metal” that is “more conductive than the first metal” after the “first metal,” or depositing a “first metal” that “has a higher resistivity than the second metal” before the “second metal.” Rather, Applicants note that in the passage cited by the Examiner, Havemann teaches deposition of the same metal, aluminum, with one aluminum layer deposited over another aluminum layer: Havemann teaches “deposition of selective metal (*e.g. aluminum*)” in a via and then “filling the conductor grooves

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(e.g. PVD or CVD **aluminum**)” over the via. Havemann, Col. 6, lines 37-54 (emphasis added). Applicants note that Havemann does not teach a combination with different metals filling the “via” and the “overlying grooves,” respectively.

While not explicitly stated, the Examiner appears to have recognized this deficiency of Havemann and appears to have asserted that Havemann inherently teaches the combinations of different metals disclosed by Applicants’ Application. In particular, as support for the assertion that combinations of metals, such as a more conductive metal over a less conductive metal, are taught by Havemann, the Examiner has pointed to a comment in Havemann that summarily states that various metal combinations are possible: the “conductors and vias of this invention will generally be either copper, tungsten or aluminum or combinations thereof.” Col. 3, lines 18-20. Other than aluminum over aluminum as discussed above, however, Havemann does not teach other particular combinations of metals. As such, Havemann’s conclusory statement regarding other combinations merely indicates that these other combinations may be possibilities. The simple statement that there are other possibilities, however, is not sufficient to establish that a particular combination among these possibilities is inherent. *See In re Robertson*, 169 F.3d 743, 49 U.S.P.Q. 2d 1949 (Fed. Cir. 1999) (“Inherency ... may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.”). Moreover, Havemann does not provide any rationale or teaching that would necessarily lead the skilled artisan to arrive at Applicants’ particular claimed combination. Consequently, Applicants submit Havemann offers a mere possibility rather than a necessary result and, as such, does not inherently teach Applicants’ claimed invention. *See Hitzeman v. Rutter.*, 243 F.3d 1345, 58 U.S.P.Q. 2d 1161 (Fed. Cir. 2001) (“consistent with the law of inherent anticipation, an inherent property must **necessarily** be present in the invention described”) (emphasis added).

Moreover, Applicants have found that less conductive metals, which the skilled artisan may find not desirable for forming wires, may nevertheless be deposited in dual damascene contact vias with advantageous results. In particular, Applicants have found that less conductive metals such as tungsten can be deposited with greater selectivity than more conductive metals such as aluminum, allowing for better coverage of a via bottom and effectively decreasing the amount of the more conductive, but less selectively deposited, metal that must be deposited into the via.

Consequently, while Applicants have disclosed the advantages of this particular combination of metals, Havemann does not contain any teaching that would necessarily cause the

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skilled artisan to form this combination, nor has Havemann explicitly disclosed the particular combination of a “second metal” over a “first metal,” where the “second metal” is “more conductive than the first metal” or where “the first metal has a higher resistivity than the second metal.” As such, Applicants respectfully submit that Havemann does not explicitly or inherently anticipate Applicants’ invention, as claimed in independent Claims 1, 11 and 17.

In addition, in the context taught by Havemann, the art of record contains no motivation to modify the teachings of Havemann to substitute a less conductive metal for the aluminum taught by Havemann for filling the contact via.

Obviousness Rejections

The Examiner has rejected Claims 3-4, 16, 12-13, 21-23 and 10 as being unpatentable over Havemann in view of various other references. In particular, the Examiner has applied Havemann as asserted against “claims 1-2, 5-9, 11, 14-15 and 17-20 above” and has applied the other references to satisfy various deficiencies of Havemann.

As discussed above, however, Havemann does not teach all that has been asserted; Havemann does not teach forming two different metals over one another, the “first metal” less “conductive” or of “higher resistivity” than the “second metal.” Because the obviousness rejections depend upon such asserted teachings, however, Applicants respectfully submit that the obviousness rejections are moot in light of the comments above.

Accordingly, Applicants respectfully submit that the pending claims are allowable over the art of record. Applicants have not specifically addressed the rejections of dependent claims as being moot in view of the remarks herein, nor have Applicants specifically addressed the asserted teachings of the art of record apart from Havemann. However, Applicants expressly do not acquiesce in the Examiner’s findings not addressed herein. Moreover, Applicants submit that the dependent claims recite further distinguishing and non-obvious features of particular utility.

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CONCLUSIONS

In view of the foregoing remarks, Applicants request entry of the amendments and reconsideration of the rejections. If some issue remains that the Examiner feels may be addressed by Examiner's amendment, the Examiner is cordially invited to call the undersigned for authorization.

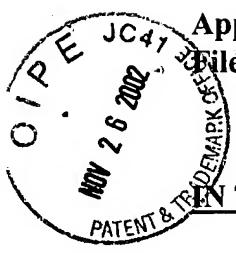
Attached hereto is a separate paper entitled VERSION OF THE AMENDMENTS SHOWING CHANGES MADE TO THE CLAIMS, in which additions are shown in double underlining and deletions are shown stricken through.

Respectfully submitted,

KNOBBE, MARTENS, OLSON & BEAR, LLP

Dated: November 20, 2002

By: Adeel Syed Akhtar 
Adeel S. Akhtar
Registration No. 41,394
Attorney of Record
2040 Main Street
14th Floor
Irvine, CA 92614
(415) 954-4114



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VERSION SHOWING CHANGES MADE TO THE CLAIMS

IN THE SPECIFICATION:

The title paragraph beginning on page 1, line 2 has been amended as follows:

METHOD OF FORMING A DUAL DAMASCENE INTERCONNECT

IN THE CLAIMS:

The following claim has been amended:

11. (Amended) A method for fabricating an integrated circuit interconnect structure, comprising:

etching a pattern of dual damascene trenches and contact vias in insulating material;

preferentially depositing a first metal into the contact vias to partially fill the contact vias; and

depositing a second metal layer by physical vapor deposition to fill a remaining portion of the contact vias over the first metal and at least partially fill the trenches, wherein the first metal has a higher resistivity than the second metal.

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